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Special Provision for Insertion Lining of Pipe Culverts

April 18, 2003

This special provision was developed by the Bureau of Materials and Physical Research as the result of discussions by the Implementation Sections of the Central Bureaus and Districts. The consensus was that the entire annular space between the existing culvert and liner pipe should be filled for all liner installations. It has been revised to require a grout mixture in lieu of controlled low strength material to fill the annular space between the liner in the existing culvert.

This special provision should be inserted into all contracts involving insertion lining of pipe culverts.

The districts should include the BDE Check Sheet marked with the applicable special provisions for the August 1, 2003 and subsequent lettings. The Project Development and Implementation Section will include the paper copy in the contract.

This special provision will be available on the transfer directory April 18, 2003.

80080m

INSERTION LINING OF PIPE CULVERTS (BDE)

Effective: November 1, 2002

Revised: August 1, 2003

Revise Section 543 of the Standard Specifications to read:

“SECTION 543. INSERTION LINING OF PIPE CULVERTS

543.01 Description. This work shall consist of insertion lining of existing pipe culverts with liner pipes and the grouting of the annular space between the existing culvert and the liner pipe.

543.02 Materials. Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Polyethylene (PE) Plastic Pipe (Note 1).....	1040.16
(b) Polyethylene (PE) Profile Wall Pipe (Note 1)	1040.18
(c) Reinforced Plastic Mortar (RPM) Pipe (Note 1)	1040.17
(d) Nonshrink Grout	1024.01
(e) Corrugated PVC with Smooth Interior (Note 1).....	1040.15
(f) Grout Mixture (Note 2)	

Note 1. Insertion linings are specified to minimum allowable inside diameters. Any of the listed pipe materials are permitted if the inside diameter requirement is met.

Note 2. The grout mixture shall be 385 kg/cu m (6.50 hundredweight/cu yd) of portland cement plus fine aggregate and water. Fly ash may replace a maximum of 310 kg/cu m (5.25 hundredweight/cu yd) of the portland cement. The water/cement ratio shall not exceed 0.60. An air-entraining admixture shall be used to produce an air content of not less than 6.0 percent nor more than 9.0 percent of the volume of the grout. The Contractor shall have the option to use a water-reducing or high range water-reducing admixture.

Nominal Size mm	PE-F-714		RPM-D3262		ProfileWall-F894		PVC-F949	
	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.
250					250	284.5	250.1	273.9
300	302.8	323.9			300	342.1	297.6	325.0
325	317.5	339.9						
350	332.5	355.6						
375					375	428.0	364.2	397.7
400	380	406.4						
450	426.7	457.2	457.2	495.3	450	514.1	445.8	486.5
500	474.2	508.0	508.0	548.6				
525					525	600.7	525.9	573.7
550	521.7	558.8						
600	569.0	609.6	609.6	655.3	600	687.3	596.1	649.7

Nominal Size mm	PE-F-714		RPM-D3262		ProfileWall-F894		PVC-F949	
	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.
675					675	772.9	671.6	733.0
700	664.0	711.2						
750			762.0	812.8	750	859.0	748.5	816.6
800	749.3	802.4						
900	853.7	914.4	914.4	922.8	900	1032.5	901.1	984.0
1000	936.0	1002.5			1000	1148.1		
1050	995.9	1066.8	1066.8	1130.3	1050	1205.7		
1200	1123.7	1203.5	1219.2	1290.3	1219.2	1365.5		
1350			1371.6	1450.3	1371.6	1536.2		
1375	1311.4	1404.6						
1500			1524.0	1597.7	1524.0	1706.9		
1600	1499.1	1605.5						
1650			1676.4	1757.7	1676.4	1877.6		
1800			1828.8	1915.2	1828.8	2048.2		
1950			1981.2	2072.6	1981.2	2218.9		
2100			2133.6	2235.2	2133.6	2389.6		
2250			2286.0	2395.2	2286.0	2560.3		
2400			2438.4	2555.2	2438.4	2731.0		

Nominal Size in.	PE-F714		RPM-D3262		Profile Wall-F894		PVC-F949	
	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.	I. D.	O. D.
10					10	11.2	9.8	10.8
12	11.92	12.75			12	13.47	11.7	12.8
13	12.50	13.38						
14	13.09	14						
15					15	16.85	14.3	15.7
16	14.96	16						
18	16.80	18	18	19.5	18	20.24	17.6	19.2
20	18.67	20	20	21.6				
21					21	23.65	20.07	22.6
22	20.54	22						
24	22.40	24	24	25.8	24	27.06	23.5	25.6
27					27	30.43	26.4	28.9
28	26.14	28						
30			30	32.0	30	33.82	29.5	32.1
32	29.5	31.59						
36	33.61	36	36	38.3	36	40.65	35.5	38.7
40	36.85	39.47			40	45.20		
42	39.21	42	42	44.5	42	47.47		
48	44.24	47.38	48	50.8	48	53.76		
54			54	57.1	54	60.48		
55	51.63	55.3						
60			60	62.9	60	67.20		
63	59.02	63.21						
66			66	69.2	66	73.92		
72			72	75.4	72	80.64		
78			78	81.6	78	87.36		
84			84	88.0	84	94.08		
90			90	94.3	90	100.80		
96			96	100.6	96	107.52		

CONSTRUCTION REQUIREMENTS

543.03 General. Prior to installing the insertion lining, the existing culvert shall receive a complete cleaning to remove all debris, sediment or other deleterious materials.

PE plastic pipe shall be joined into a continuous length by the butt fusion method according to ASTM D 2657 or by an approved screw-on or push-on joint. PE profile wall pipe shall be joined by heat fusion, extrusion, welding, screw-on or other approved connections. RPM pipe or corrugated PVC with smooth interior shall be joined according to the manufacturer's recommendations using joint lubricant. The joining may be accomplished in a jacking pit or other convenient location where the assembled liner can be brought into alignment with the existing culvert bore without damage. The Engineer shall approve each joint before each section of liner pipe is inserted.

The insertion may be made by pushing or pulling the assembled liner pipe from either end of the culvert. The insertion operation shall not cause the joints to separate in any way. The Engineer may require the liner to have a temporary nose cone or plug to guide the liner pipe past minor obstructions. The handling of plastic liner pipe shall be such that the pipe is not damaged. Pipe with deep scratches or gouges shall be removed and replaced by the Contractor at his/her own expense.

After the liner pipe has been completely inserted and has been inspected in place by the Engineer, it shall be cut off flush with the ends of the existing culvert or as otherwise directed by the Engineer. Liner pipe shall be allowed to cool to the temperature of the existing culvert before it is cut off. The entire length of the annular space between the existing culvert and the liner pipe shall be filled with a grout mixture.

Prior to filling the annular space, the upstream and downstream ends of the annular space between the existing culvert and the liner pipe shall have a cement mortar mixture grout stop. The mixture shall be one part cement and two parts sand. The grout stop shall be no closer than 150 mm (6 in.) from the end. Holes shall be required at the grout stop to allow air to escape when pumping grout and to allow verification that the annular space has been filled with grout.

When the grout is pumped into the annular space between the existing culvert and liner pipe, the contractor shall prevent the floating of the liner pipe. This shall be accomplished by any of the following methods:

- (a) Intermittent Pumping Method. Small amounts of grout shall be pumped into the annular space and allowed to harden. This shall continue until the bond between the liner pipe and grout is sufficient to resist floating. The remainder of the annular space shall then be filled.
- (b) Bracing Method. Braces shall be installed in the annular space to prevent floating of the liner pipe. Only braces which do not damage the liner pipe shall be used.

(c) Water Fill Method. The liner pipe shall be temporarily filled with water before filling the annular space with grout.

(d) Other Methods. Other methods may be used with the approval of the Engineer.

The pumping operation shall effectively fill the annular space along the entire length, but shall be performed in a manner that shall not distort the liner pipe. The pressure developed in the annular space shall not exceed the liner pipe manufacturer's recommended value.

Upon completion of the pumping operation, the remaining 150 mm (6 in.) at the upstream and downstream ends shall be filled with a nonshrink grout. Only enough water to make a stiff but workable nonshrink grout shall be used.

543.04 Method of Measurement. This work will be measured for payment in meters (feet) in place.

543.05 Basis of Payment. This work will be paid for at the contract unit price per meter (foot) for INSERTION CULVERT LINER of the inside diameter specified.

Excavation in rock will be measured and paid for according to Section 502."

Revise Article 1040.18 of the Standard Specifications to read:

"1040.18 Polyethylene (PE) Profile Wall Pipe Liner. Polyethylene (PE) profile wall pipe liner shall conform to the requirements of ASTM F 667 for sizes 250 to 375 mm (10 to 15 in.) and to ASTM F 894 for sizes 450 to 2400 mm (18 to 96 in.). All sizes shall have wall construction that presents essentially smooth internal and external surfaces. The pipe liner shall have a minimum pipe stiffness of 320 kPa (46 psi) at five percent deflection for nominal inside diameters of 1050 mm (42 in.) or less. For pipes with a nominal inside diameter greater than 1050 mm (42 in.) the pipe liner shall have a minimum pipe stiffness of 224 kPa (32.5 psi) at five percent deflection."